

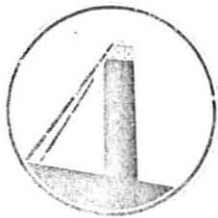
DISCHARGE

PLAN FILE

Project

No.

DP-20

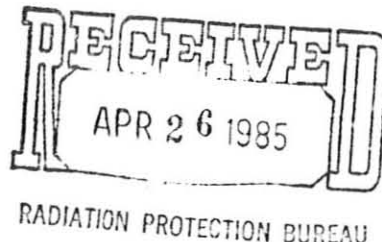


Hecla Mining Company

April 18, 1985

Certified Mail--Return Receipt Requested

Mr. Felix R. Miera, Jr.
Program Manager
Uranium Licensing Section
State of New Mexico
Environmental Improvement Division
PO Box 968
Santa Fe, New Mexico 87504-0968



Dear Mr. Miera:

In response to your letter of April 2, 1985, Hecla Mining Company successor to Ranchers Exploration and Development Corporation's interests in the Johnny M mine is in strong disagreement to an unconditioned indefinite extension of Radioactive Materials License NM-RED-MB-15. Since Hecla Mining Company is unfamiliar with the history of the site, we wish to review the files and examine the site. We then wish to meet with the Division to come to an understanding on final termination for this license. Upon completion of our review, we will contact the Division to arrange a meeting.

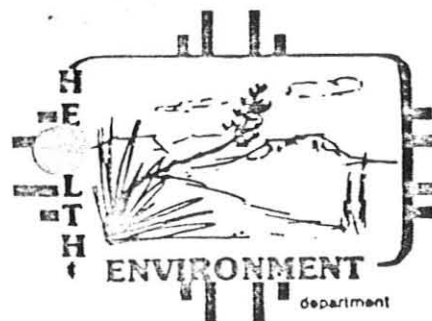
Sincerely,

Michael B. White
Counsel and Assistant Secretary

MBW/js

TONEY ANAYA
GOVERNOR

DENISE D. FORT
DIRECTOR



STATE OF NEW MEXICO

ENVIRONMENTAL IMPROVEMENT DIVISION

P.O. Box 968, Santa Fe, New Mexico 87504-0968
(505) 984-0020

April 2, 1985

Ms. Colleen Kelley
Environmental Supervisor
Hecla Mining Company
P.O. Box 320
Wallace, Idaho 83873

Dear Ms. Kelley:

As indicated to you in our phone conversation of March 29, 1985, Radioactive Material License NM-RED-MB-15 is extended in the license amendment attached to this correspondence for an indefinite period of time pending accomplishment and resolution of the previously agreed upon reclamation objectives. As I indicated to you in our conversation, a survey has been conducted by our Surveillance and Assessment Section (SAS) at the mine backfilling sites (designated as North Bore Hole Area and South Bore Hole Area). This survey shows that efforts to date by Ranchers Exploration and Development Company have been unsuccessful in isolation of the original backfill materials and in revegetation of the site.

External exposure rate data presented in the Johnny M. Mine Termination report showed no significant change in mean $\mu\text{R/h}$ levels through three separate phases of reclamation at the North Vent Hole. The mean level was 158 $\mu\text{R/h}$ following the initial step by Ranchers when "all backfill material and debris were removed from the areas by loading and scraping." This level greatly exceeded the agreed upon target of 25 $\mu\text{R/h}$ in accordance with the ALARA principle. At the South Vent Hole, there was a significant increase in mean external exposure levels from the initial (47 $\mu\text{R/h}$) to final cleanup (183 $\mu\text{R/h}$).

Attachments 1 and 2 show the location of soil sampling sites and radionuclide concentrations in eight soil samples collected by the SAS. Samples obtained from post reclaimed areas (#5, 8), showed relatively high concentrations of radionuclides, but were depleted in U-238 and U-234. Sample #2 obtained from the perimeter of the licensed area also showed relatively high concentrations of nuclides of the uranium decay chain, but was also depleted of uranium. All three samples clearly show the presence of exposed backfill materials. However, samples from background materials, reportedly used for cover materials (#1, 3, 6 and 7), showed concentrations from 1-3 pCi/g for all radionuclides. Sample #4 from a nearby sandstone formation also had relatively low concentrations of radionuclides (4-5 pCi/g). Attachment 3, showing a gamma spectrum from samples #1 and #2, demonstrates the

Ms. Colleen Kelley
April 2, 1985
Page 2

differences in the levels of activity and the depleted uranium in sample #2 for peaks at 320 kev and 460 kev, when compared to a standard pitchblend sample which has all U-238 decay chain nuclides in secular equilibrium.

Since the reported cover materials are very low in radionuclide concentrations, and backfill materials have been found at the surface of both licensed areas, it must be assumed that the original backfill materials were not adequately removed or isolated.

As I further indicated to you in our phone conversation, the Division will be glad to meet with you at your convenience to determine how we can best resolve the apparent discrepancies at these sites. Please feel free to contact me should you have further questions.

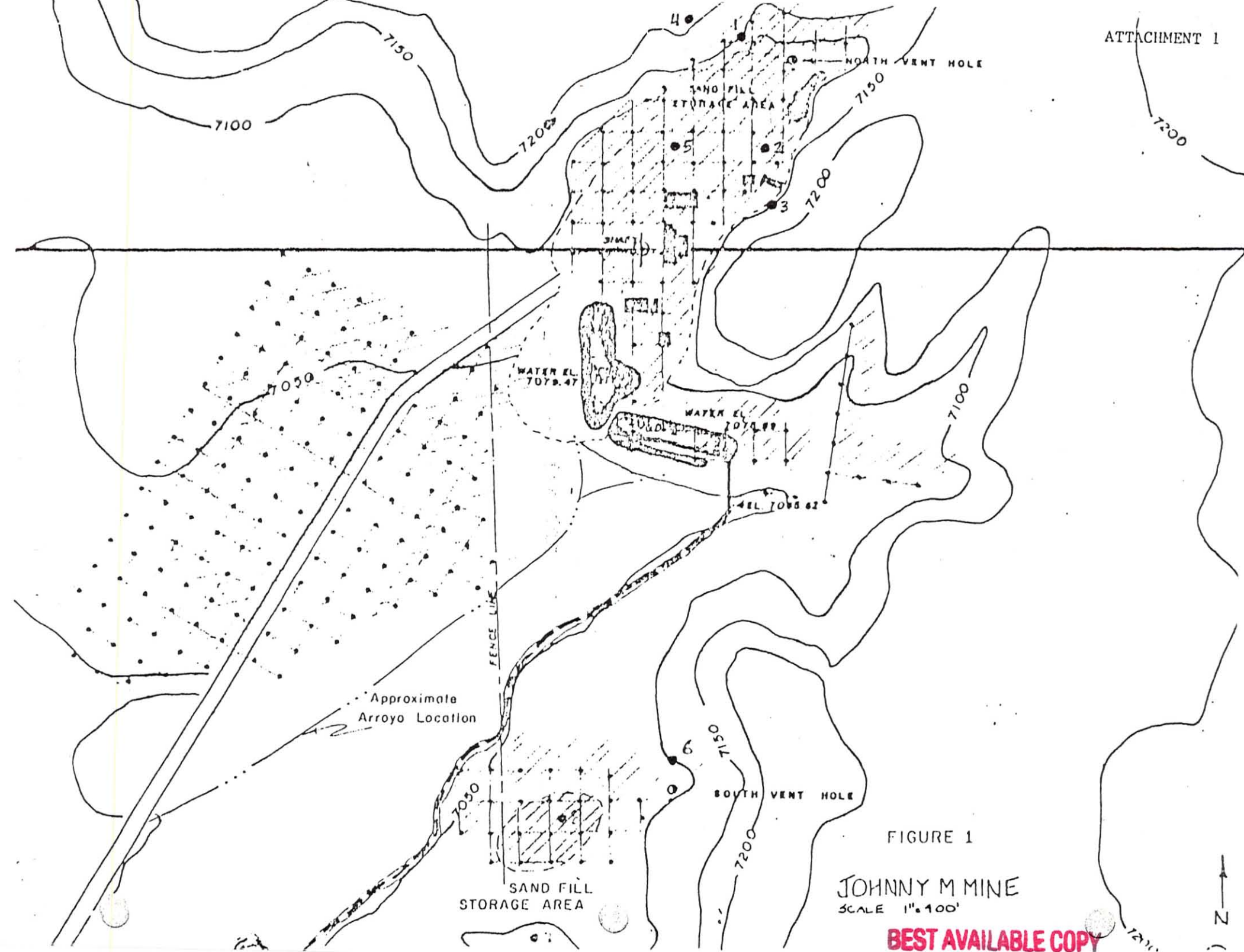
Respectfully,

Kenneth M. Hargis for

Felix R. Miera, Jr.
Program Manager
Uranium Licensing Section

FRM/cvg

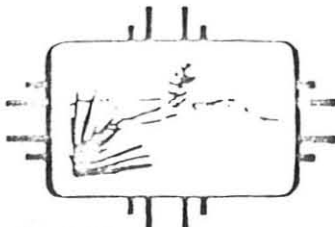
cc: Richard Young, Legal Services Bureau
Andrea Smith, Legal Services Bureau
Ken Hargis, Chief, Radiation Protection Bureau
Jere Millard, Radiation Protection Bureau



BEST AVAILABLE COPY

Summary: Specific Radiochemical Analysis
J. Millard's 8-Soils Project

| Sample: RC-84- Analysis | 0257 (Jere's #1) | 0258 (Jere's #2) | 0259 (Jere's #3) | 0260 (Jere's #4) | 0261 (Jere's #5) | 0262 (Jere's #6) | 0263 (Jere's #7) | 0264 (Jere's #8) |
|----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| U-238 (pCi/g) | 2.2 | 10.8 | 2.4 | 5.2 | 30. | 1.6 | 1.5 | 12.6 |
| U-234 (pCi/g) | 2.1 | 17.3 | 1.9 | 4.0 | 36. | 1.7 | 1.1 | 19.5 |
| U-234/U-238 Ratio | 0.97 | 1.59 | 0.81 | 0.76 | 1.22 | 1.10 | 0.72 | 1.56 |
| Th-230 (pCi/g) | 1.2 | 97. | 1.7 | 3.1 | 173. | 2.4 | 1.3 | 122. |
| Ra-226 (pCi/g) | 2.3 | 315. | 0.9 | 4.2 | 270. | 1.2 | 1.0 | 225. |
| Pb-210 (pCi/g) | 1.7 | 365. | 1.6 | 4.5 | 306. | 1.3 | 2.5 | 299. |



ENVIRONMENTAL IMPROVEMENT DIVISION
RADIOACTIVE MATERIAL LICENSE

License Number NM-RED-MB-15 is amended to become License Number NM-RED-MB-16

Ms. Colleen Kelley
Environmental Supervisor
Helca Mining Company
P.O. Box 320
Wallace, Idaho 83873

Per telephone conversation of March 29, 1985, between Colleen Kelley and Felix R. Miera, Jr., subject license is amended as follows:

Change Condition No. 21. to read:

21. The expiration date of this license is hereby extended until such time as the licensee completes all reclamation activities and resolution of stated objectives of the June 22, 1982 correspondence to the licensee, and the August 23, 1983 termination report submitted by the licensee.

Date: April 2, 1985

For the New Mexico HED Environmental Improvement Division

By

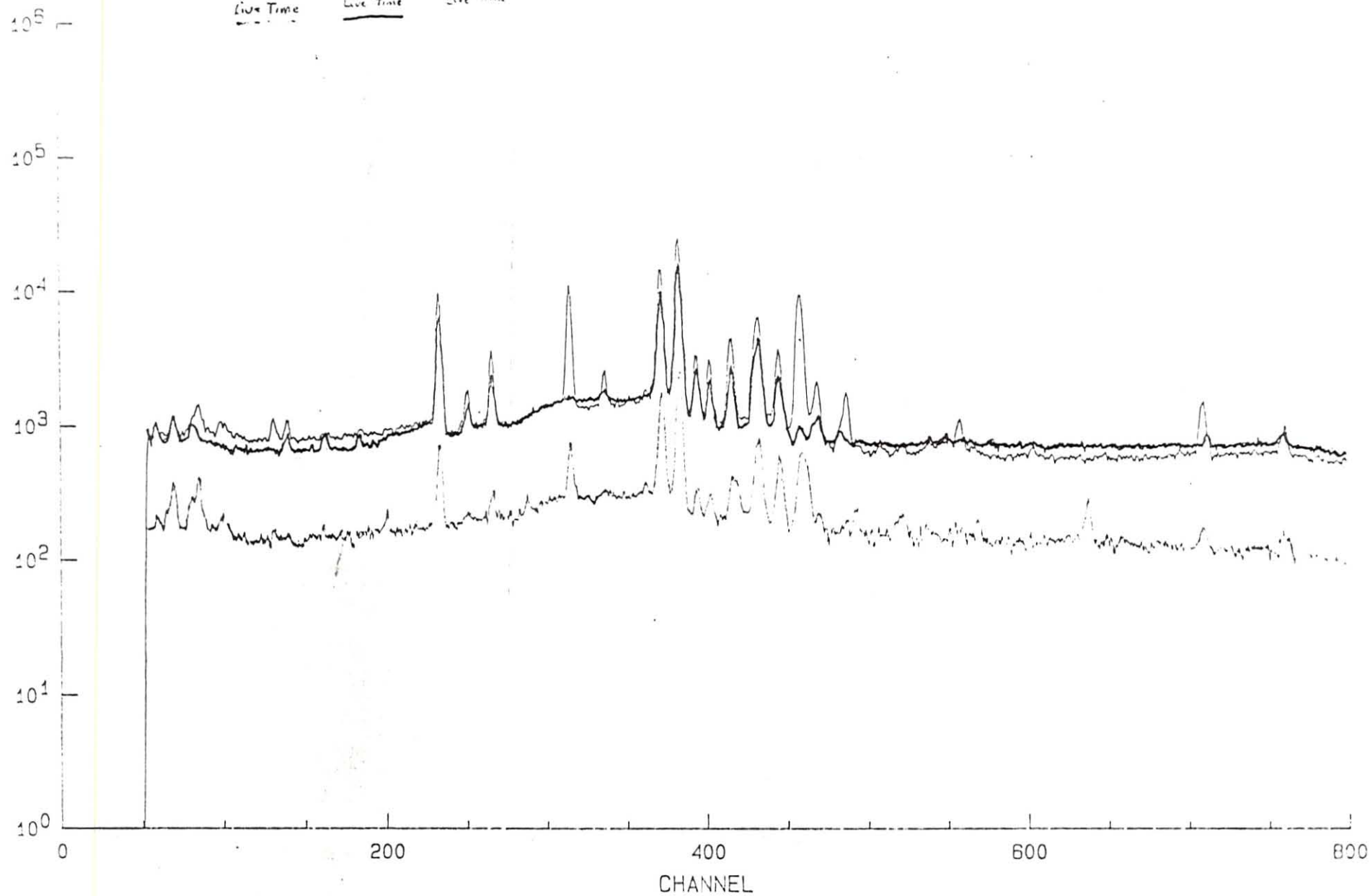
Kenneth M. Hoyer
Felix R. Miera, Jr.,
Health Program Manager

Comparison:

Low Activity
Juno's #1
60000 Sec
Live Time

High Activity
Series #2
4000 Sec
Live Time

High Activity
Juno's #2
4000 Sec
Live Time



Termination Report

Johnny M Mine





RANCHERS EXPLORATION AND DEVELOPMENT CORPORATION

Box 6217 / 1776 Montano Road, N.W. / Albuquerque, New Mexico 87197
Telephone (505) 344-3542 / TWX 910 989 1688 RANC EXPLO ABQ
TLX 66 0422 RAN EXP ALB

August 23, 1983

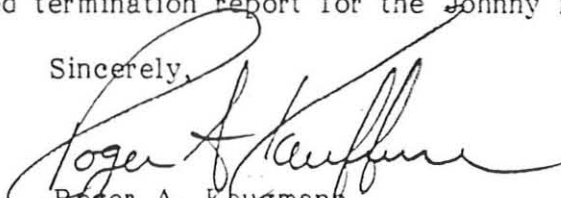
Mr. L. C. Landauer
Project Manager
Uranium Licensing Section
N.M.E.I.D.
P. O. Box 968
Santa Fe, NM 87504-0968

Re: Your letter of March 10, 1983

Dear Mr. Landauer:

In response to the above referenced letter, the following information, discussion and figures are submitted as the required termination report for the Johnny M Mine.

Sincerely,


Roger A. Kaugmann
Senior Staff Engineer

RAK:cje

Background and Location

The Johnny M Mine is located on the eastern end of the Ambrosia Lake Uranium District, Sections 7 and 18, T. 13N., R. 8W., McKinley County, New Mexico. Development of the mine commenced in late 1972 with the production cycle beginning in early 1976 and being complete with the exhaustion of ore reserves in early 1982. The mining sequence at the Johnny M Mine included the backfilling of mined-out working places with uranium mill tailings, and as a result of the backfill activity, two small surface locations were required for the storage of the backfill material. Figure 1 is a map showing the general surface plant detail and the locations of the sandfill storage areas by the north and south vent holes covered by our N.M. Radioactive Material License.

Reclamation Activity

Reclamation of the mine property began in early 1982 and followed the general sequence of events as described and subsequently discussed with your agency in our letter of January 14, 1982.

The reclamation of the backfill storage areas was carried out in three primary steps. Initially, all backfill material and debris were removed from the areas by loading and scraping. The second step included recontouring the areas, removing and disposing of any anomalous material and the blading and covering of the areas with unaffected adjacent material. The final step was completed by again removing and disposing of any anomalous locations and the blading and covering of the north area with 12 to 24 inches of unaffected adjacent material and 6 to 12 inches at the south location.

Gamma Surveys

Gamma surveys of the licensed areas were conducted throughout the reclamation activity. Surveys were performed by both Ranchers' staff and EID field personnel. Each survey followed a distinct phase of reclamation activity which was conducted with the prior knowledge and approval of the EID. Data for the three base surveys are listed in Table 1 and Table 2 and have corresponding location details on Map Detail N-1 through N-3 and S-1 and S-3 which are expansions of the Figure 1 grid.

The initial and second clear-up surveys were conducted by Ranchers using a 100 foot grid pattern and Kerr McGee Corporations' Mesa 2 gamma survey meter. The final clean-up survey was carried out by the Milan field office of the EID.

A summary of the gamma survey data, background concentrations, and limitation values are as follows:

| <u>North Bore Hole Area</u> | <u>South Bore Hole Area</u> | <u>Description</u> |
|---------------------------------|---------------------------------|---|
| 7 ur/hr | 7 ur/hr | Cosmic radiation (See Figure 2) |
| + - 105 ur/hr | + - 82 ur/hr | Cover material background average (See Table 3 and Figure 3) |
| 112 ur/hr | 89 ur/hr | background subtotal |
| <u>25 ur/hr</u> | <u>25 ur/hr</u> | goal value (above back.) |
| 137 ur/hr | 114 ur/hr | background plus goal |
| <u>57 ur/hr</u> | <u>57 ur/hr</u> | limitation valve |
| 169 ur/hr | 146 ur/hr | background plus limitation (above back.) |

Reviewing the above data the following is noted:

- 1) That upgrading of cleanup effort, agreed upon in advance by EID and company personnel, by the addition of adjacent cover material has, in most cases, caused higher level gamma results.
- 2) The north bore hole area is slightly above target and within limitation standards.
- 3) The south bore hole area which was seriously degraded in the process of a joint effort striving to improve the location falls within the limitation standard with the removal of the two most anomalous data points. One data point being outside the immediate area of interest and both "points" being attributed to material from unregulated drilling and mining activity to which no licensing is applicable.

Radium 226 Concentration

The radiochemical soil analysis for the areas are listed in Table 3 as provided by the Milan field office of the EID.

The analyses show significant higher background in adjacent soils as compared to the original analysis of soil from the arroyo located in Section 18 northwest of the south vent hole area.

Although initially considered for cover material, it was later decided that removal of the material would involve an ownership problem, create erosion damage, and not necessarily provide uniform radium 226 background concentration.

Radon 222 Air Concentrations

A summary of the radon 222 concentrations are listed in Figure 4. The summary is an inter-agency EID memorandum showing concentration of $0.14 \pm .16$ Pci/l for the north area and $0.42 \pm .24$ Pci/l for the south area. Both areas fall within the 3.0 Pci/l annual average.

Annual Indoor Radon Decay

All buildings have been removed from the licensed areas which included an operators' enclosure and an emergency hoist building. Buildings that remain on the property are unoccupied and are outside the areas of concern, will be removed in conjunction with equipment disposal, and have no history of radon decay product concentration.

In addition to the current absence of building on the concerned areas, neither the property owners nor Ranchers anticipates future building or inhabitation of the remote privately-owned areas.

Photographs of Areas

Four photographs have been provided of the reclaimed areas. Photographs 13 and 18 are of the north vent hole location with No. 13 looking south, southwest, and No. 14 looking north, northeast. Photographs 22 and 30 are of the south vent hole location. Both photographs were taken from approximately the south vent hole looking south, southwest.

SUMMARY OF NORTH BORE HOLE GAMMA SURVEYS

TABLE 1

| Data Location | Initial cleanup Survey May 1982 μr/hr | Second cleanup Survey 6-16-82 μr/hr | Final; cleanup Survey 8-17-82 μr/hr |
|------------------|---|---|---|
| 3-2 | .160 | — | .200 |
| 3-3 | .094 | .067 | — |
| 3-4 | .180 | .071 | — |
| 3.5-4 | — | — | .200 |
| 4-2 | — | .130 | .220 |
| 4.24-2.5 | — | — | .200 |
| 4-3 | .250 | .190 | .180 |
| 4.25-3.25 | — | — | .180 |
| 4-4 | .095 | .046 | — |
| 4.5-3.5 | — | — | .200 |
| 5-2 | .290 | .130 | .100 |
| 5-3 | .095 | .052 | .150 |
| 5-3.5 | — | — | .120 |
| 5-4 | — | .080 | — |
| 5.5-3.25 | — | — | .080 |
| 5.5-4 | — | — | .060 |
| 6-2 | — | .190 | .150 |
| 6-3 | .099 | .071 | — |
| 6-4 | — | .073 | .100 |
| | <hr/> | <hr/> | <hr/> |
| | .158 | .100 | .153 |

SUMMARY OF SOUTH BORE HOLE GAMMA SURVEYS

TABLE 2

| Data Location | Initial cleanup Survey May 1982 μr/hr | Second cleanup Survey 6-16-82 μr/hr | Final; cleanup Survey 8-17-82 μr/hr |
|------------------|---|---|---|
| 1-4 | .041 | .030 | — |
| 1-5 | .045 | .041 | — |
| 1-6 | .012 | .013 | — |
| 2-4 | .026 | .046 | .170 |
| 2-5 | .240 | .024 | .240 |
| 2-6 | .013 | .073 | .140 |
| 3-4 | .073 | .055 | .110 |
| 3-5 | .039 | .031 | .085 |
| 3-5.5 | — | — | .420 |
| 3-6 | .011 | .028 | .054 |
| 4-4 | .066 | .064 | .110 |
| 4-5 | .022 | .290 | .154 |
| 4-5.5 | | | .100 |
| 4-6 | .020 | .026 | .150 |
| 5-4 | .059 | .120 | .034 |
| 5-4.5 | — | — | .110 |
| 5-5 | .026 | .031 | .200 |
| 5-6 | .013 | .019 | .670 |
| | <hr/> | <hr/> | <hr/> |
| | .047 | .060 | .183 |

15/ur/hr

Radiochemical analysis of soil samples from Rancher's Johnny-M Mine.

Analysis done by Eberline in their Albuquerque Laboratories.

The results, reported 11/10/82 were as follows:

| <u>SAMPLE</u> | <u>TYPE</u> | <u>DATE COLLECTED</u> | <u>Pci/g(dry)</u> |
|---------------|--|---------------------------|---|
| R-N-1 | N Bore hole, Westside. Composite of fill material from base of cliff (Samples X1, X2, X8, X9, composited) | 9/1/82 | $45 \pm 14 \times 1.2 = 81.00$ w/v |
| R-N-2 | N Bore Hole, NE Side Composite of fill material from edges and side of Rd. fill (Samples X10, X11, X12, composited) | 9/1/82 | $68 \pm 10 \times 1.2 = 122.4$ w/v |
| R-N-3 | N Bore Hole, across Fill Near bore hold (Samples X3, X4, X5, X6, X7, composited) | 9/1/82 | $62 \pm 19 \times 1.2 = 111.6$ <u>105.00</u> |
| R-S-1 | S Bore Hole, composite of fill material from base of hills of SE border (6 samples composited) | 9/1/82 | $24 \pm 7 \times 1.2 = 43.2$ w/v |
| R-S-2 | S Bore Hole, composite of samples taken across covered area from SE to NW (7 samples composited) | 9/1/82 | $68 \pm 20 \times 1.2 = 122.40$ <u>82.8</u> |

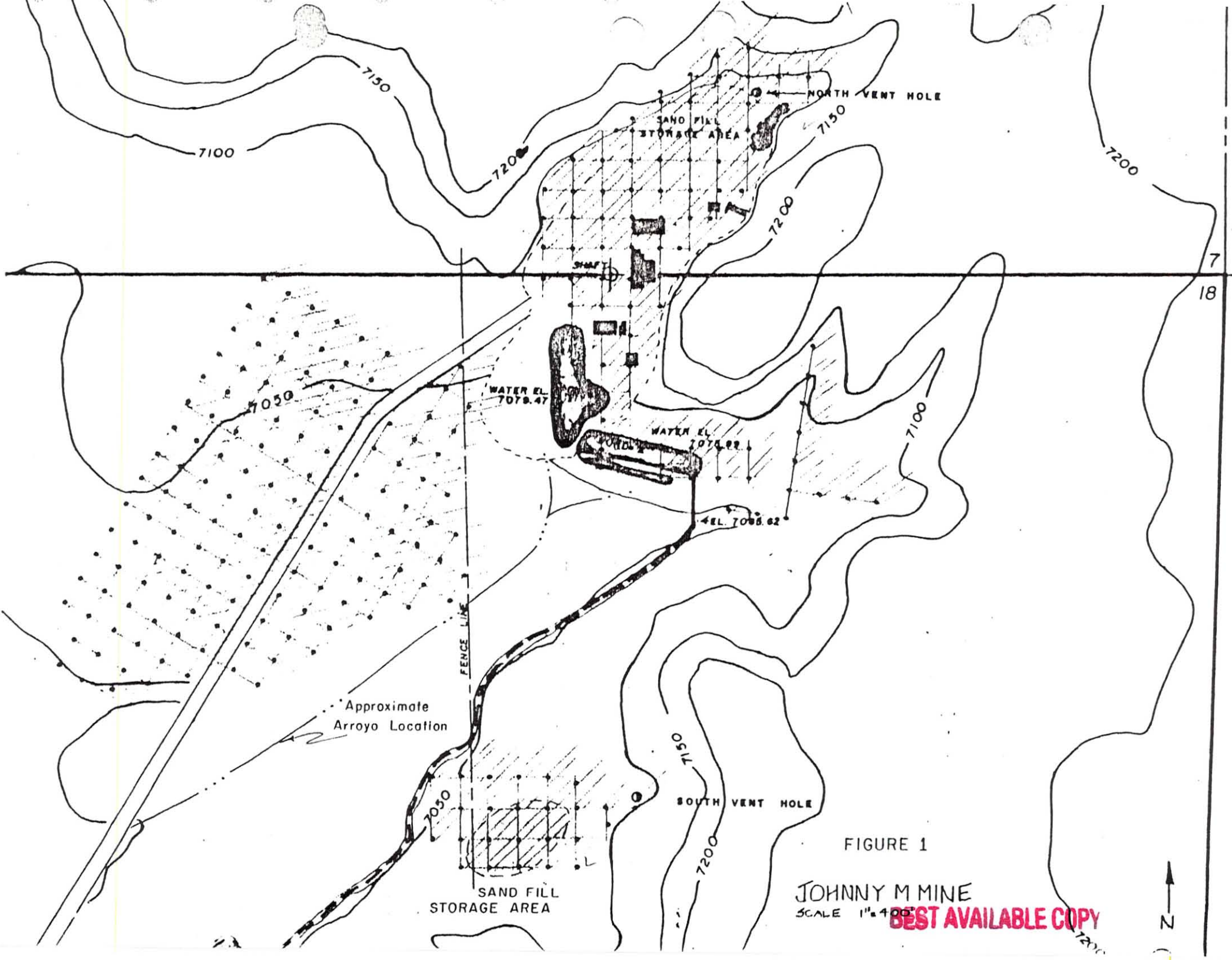


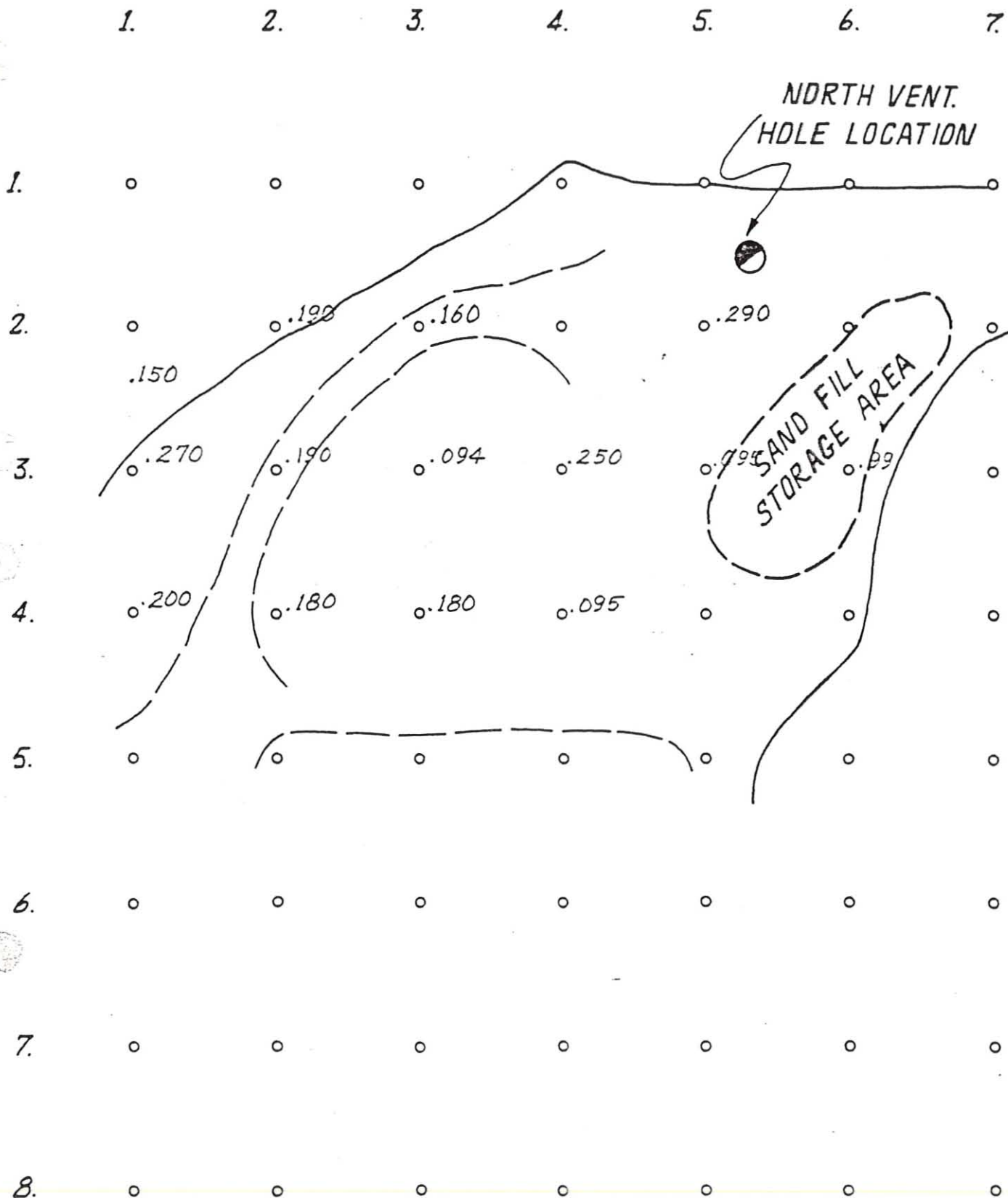
FIGURE 1

JOHNNY M MINE

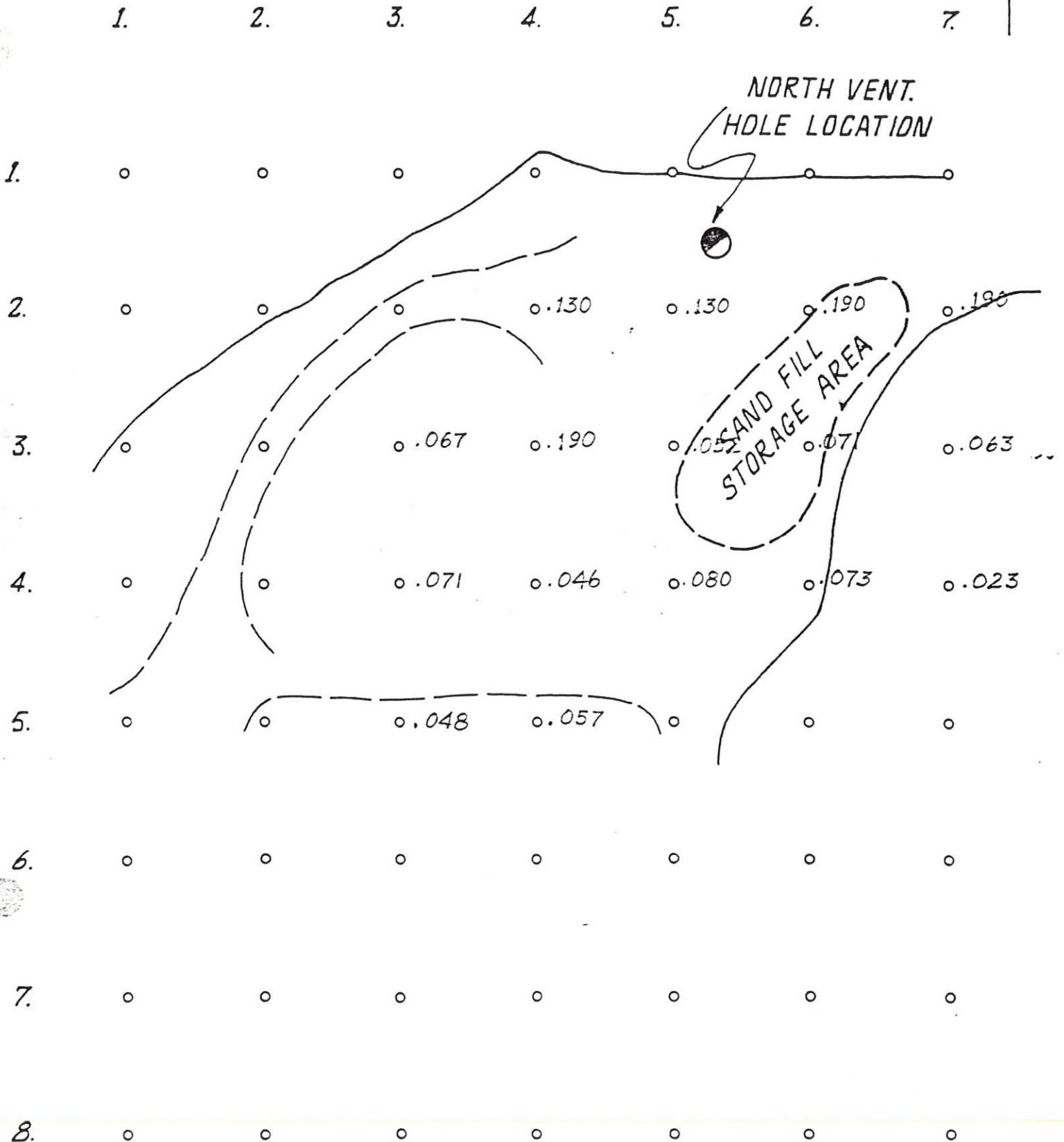
SCALE 1" = 400'

BEST AVAILABLE COPY

BEST AVAILABLE COPY



Map Detail N-1
Original Survey North Bore Hole (mr/hr)
May 1982



Map Detail N-2

North Bore Hole After Initial Clean Up Work (mr/hr)

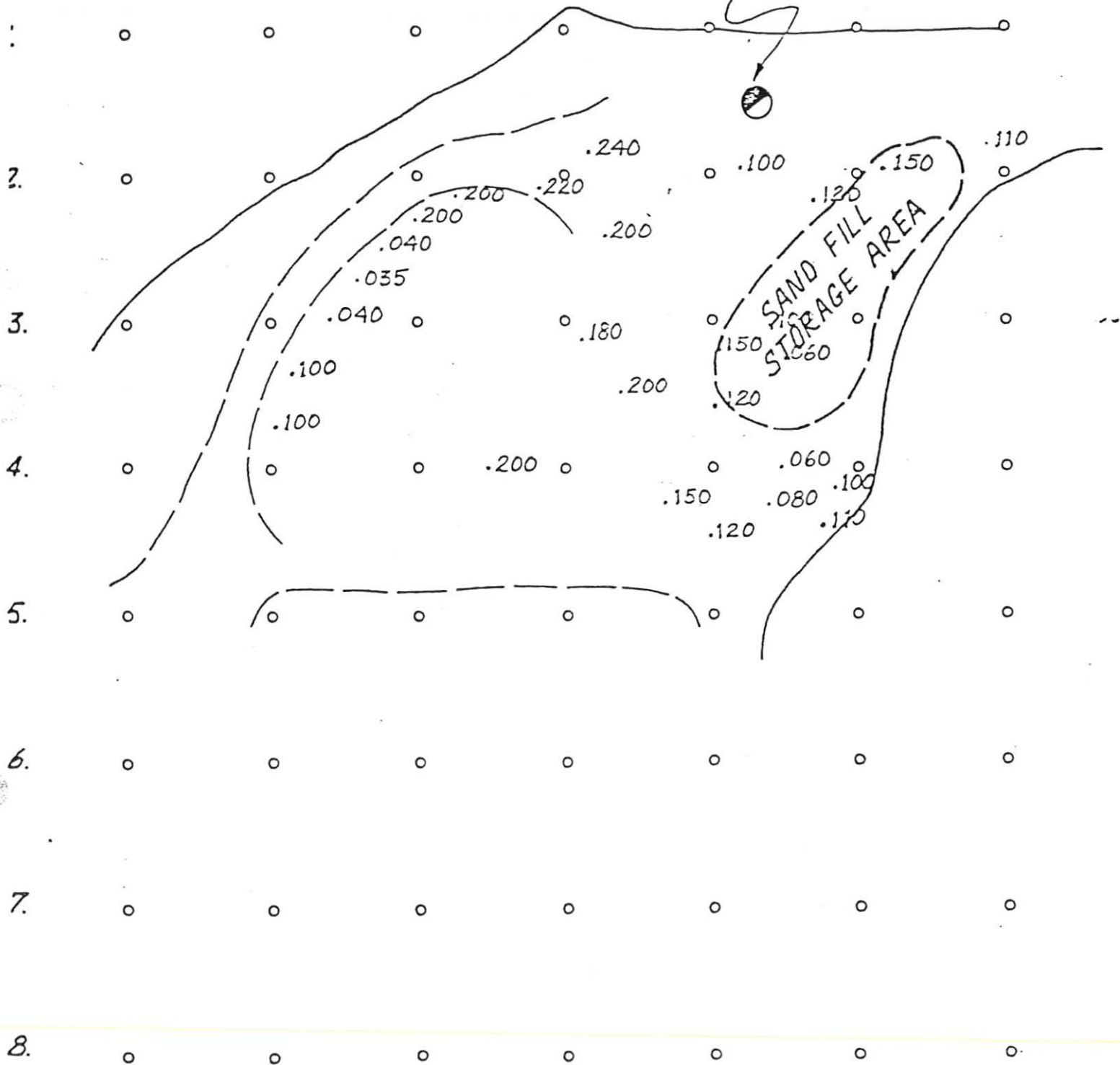
JUNE 16 1988

BEST AVAILABLE COPY



1. 2. 3. 4. 5. 6. 7.

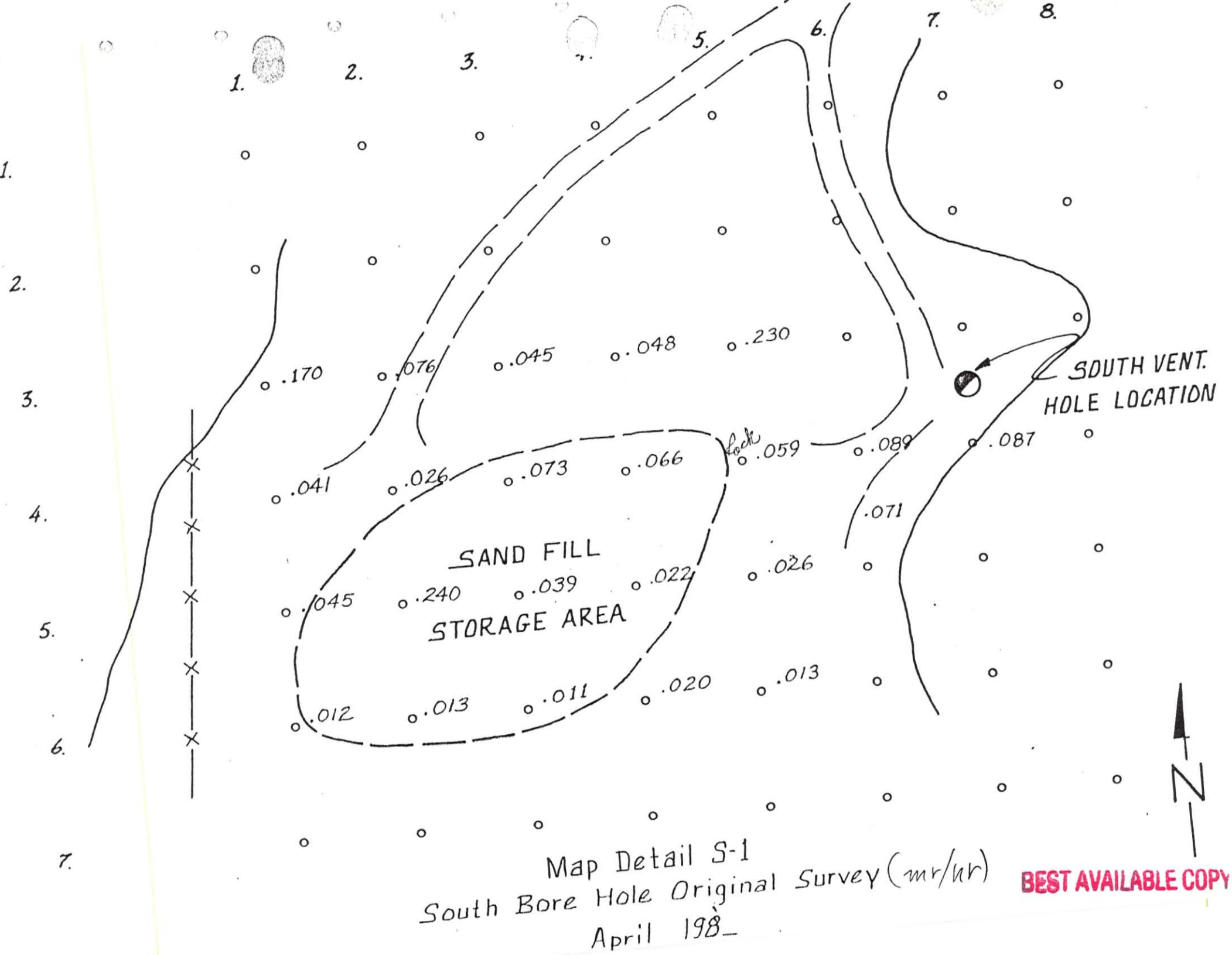
NORTH VENT.
HOLE LOCATION

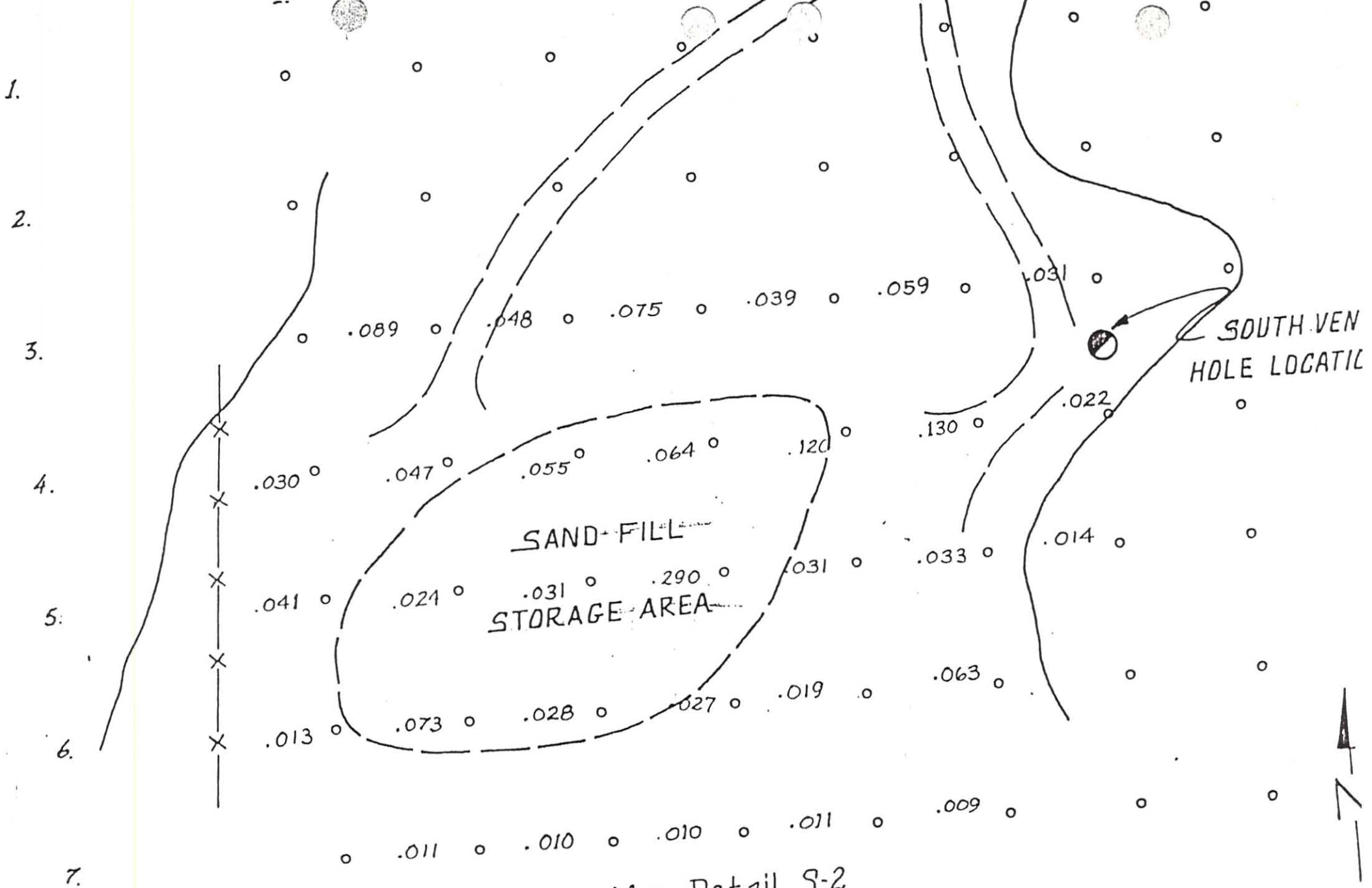


Map Detail N-3

North Bore Hole After Second Dozer Work

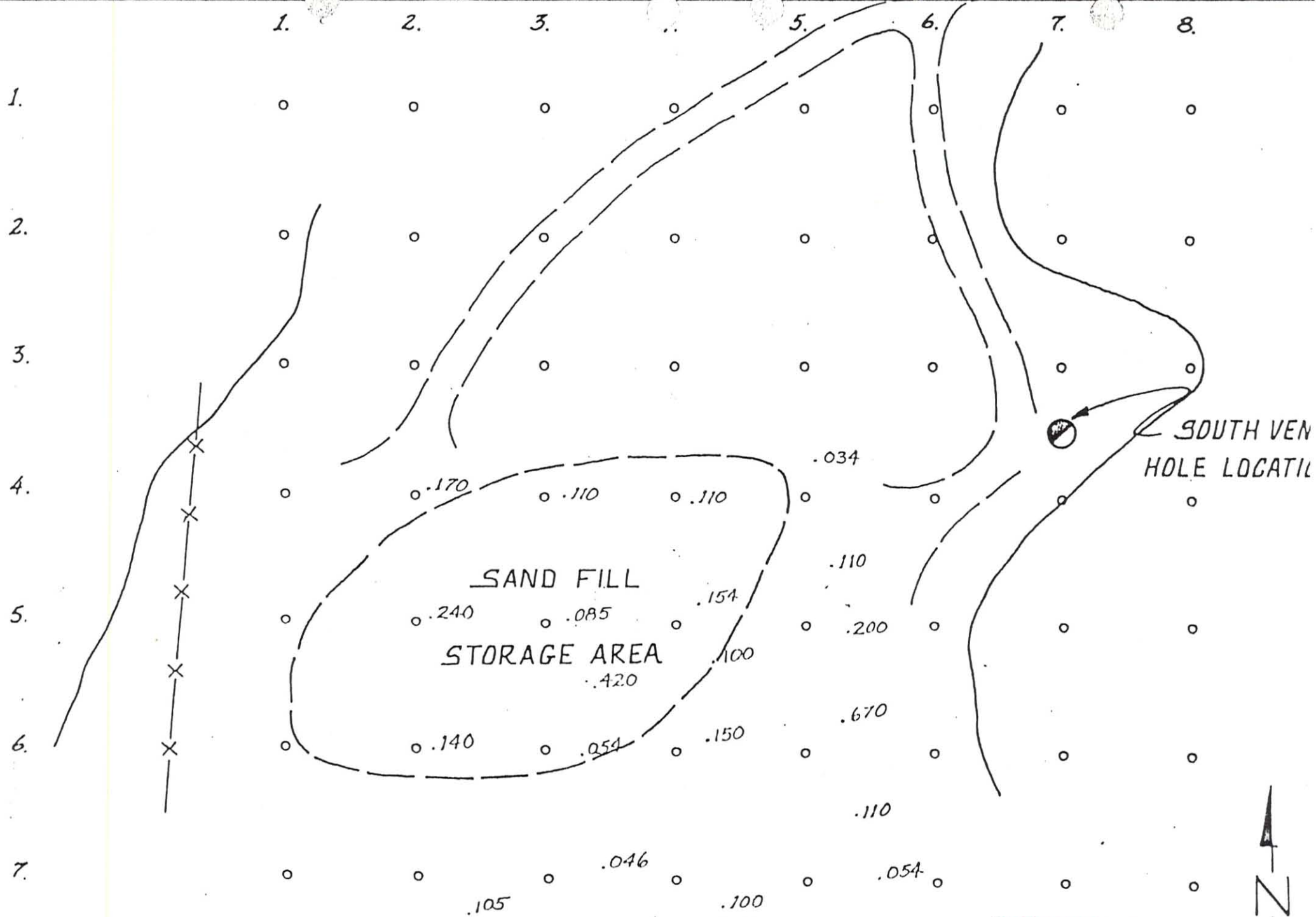
Will Bank Fill 8-17-82 FID Survey





Map Detail S-2
South Bore Hole After Initial Dozer Work
May 20 1982

BEST AVAILABLE COPY



Map Detail S-3
South Bore Hole After Second Dozer Work
MAY 10 1962

BEST AVAILABLE COPY

E.I.D. Survey

Yamashita *et al.*, 1966). The neutrons with energies above 0.1 MeV are of greatest dosimetric significance because of the rapid increase with energy up to ~ 10 MeV of the tissue absorbed dose or dose equivalent rate per unit incident flux density (NCRP, 1971).

The angular distributions of the various components of the cosmic radiation deep in the atmosphere are strongly directed toward the vertical. They can be closely approximated by the function $\cos^n \theta$, where θ is the angle from the vertical direction. For muons, $n = 2.1$ (Crookes and Rastin, 1972), while for electrons and nucleons, n was estimated for this report to be in the range of 3 to 5.

2.3 Cosmic-Ray Absorbed Dose Rates in Air

The most frequently encountered unit of total cosmic ray intensity in the atmosphere is free air ionization density rate I (units of ion pairs per $\text{cm}^2 \cdot \text{s}$ at standard temperature and pressure (STP), which is related to absorbed dose rate in air by the formula $I \equiv 1.50 \mu\text{rad/h}$. Measurements of charged particle ionization have been conducted for over forty years by the group at the California Institute of Technology (CIT) led by Millikan and later by Neher (e.g., see Neher, 1952; 1971), using argon-filled, steel-walled ionization chambers. Similar measurements have been conducted by other groups (e.g., Nerurkar and Webber, 1964; Raft *et al.*, 1970; Lowder *et al.*, 1972), with some disagreement in absolute values (Lowder and Beck, 1966; George, 1970; Raft *et al.*, 1970; Carmichael, 1971; Liboff, 1975). A similar disagreement has been noted in the lower atmosphere between the data of George (1970), using the CIT pressurized argon chamber and a large air-filled chamber, and those of Lowder and Beck (1966), Shamos and Liboff (1966), and Liboff (1975). As the latter sets of data seem to be more consistent with the known properties of the cosmic-ray field at ground altitudes, discussed in Section 2.2, we make use of them to infer the altitude profile of the cosmic-ray air dose rate in the lower atmosphere given in Figure 7. Analogous high altitude profiles are shown in Figure 8, based on data obtained at various geomagnetic latitudes (λ_m) during the 1958 solar activity maximum⁴ (Anderson, 1961) and during the following 1965 minimum (Neher, 1967). These high altitude results have been corrected according to the recommendations of Carmichael (1971), and are consistent with the 1969-70 (solar maximum) profiles of Lowder *et al.*

⁴ It should be noted that the period of maximum solar activity corresponds to the minimum in cosmic-ray intensity.

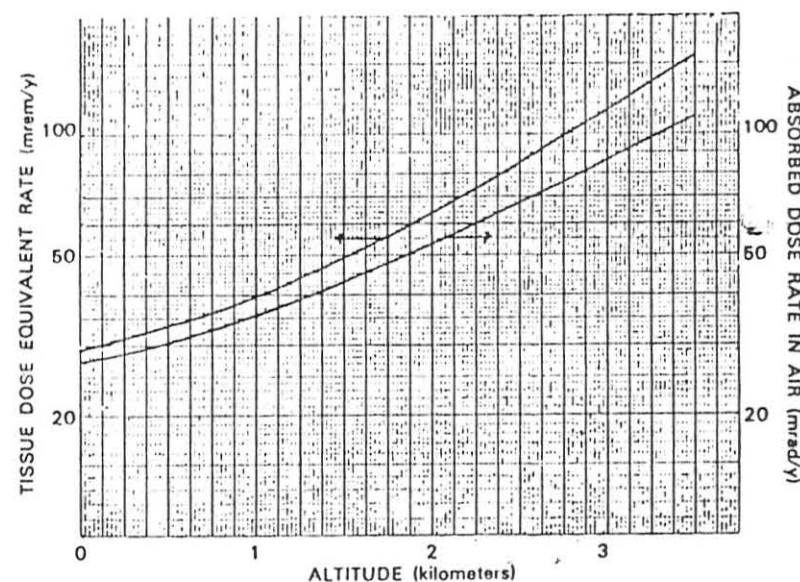


Fig. 7. Long-term average dose from cosmic radiation. The charged particle absorbed dose rate in air or tissue is shown in the lower curve and the total dose equivalent rate (charged particles plus neutrons) is shown in the upper curve at 5 cm depth in a 30 cm thick slab of tissue.

(1972). The differences in the amplitudes and shapes of the profiles illustrate the effects of the 11-year solar activity cycle and of the earth's geomagnetic field in changing the total intensity of primary cosmic-ray particles incident on the top of the atmosphere and in preferentially influencing the lower energy particles. At ground altitudes and the latitude range of the continental United States, the variation in cosmic-ray charged particle intensity due to the geomagnetic field effect is less than 2 percent (Carmichael and Bercovitch, 1969), while the 11-year variation due to the solar activity cycle has a maximum amplitude of less than 10 percent of the mean level. For purposes of dose assessment, the curve in Figure 7 can be regarded as providing reasonable long-term average values of cosmic-ray air (and tissue) absorbed dose rate at various altitudes in the continental United States.

Relatively few measurements have been made of the cosmic-ray neutrons in the atmosphere. Interpretation is complicated since the neutron intensity is much more sensitive than the charged particle intensity to the time and space variations of the low energy (~ 1 GeV) primary radiation at the top of the atmosphere. Detailed flux density calculations have been carried out by O'Brien (1971) and Armstrong *et al.* (1973), but the absolute values at ground level are in serious disagreement. The

2.3 ENVIRONMENTAL RADIATION FIELDS / 39

TABLE 2-18—Calculated total exposure rate at one meter above ground for natural emitters uniformly distributed in the soil^a

| Isotope | Exposure Rate/Radionuclide Concentration | |
|-------------------------------|--|--|
| | $\mu\text{R h}^{-1}/\mu\text{Ci g}^{-1}$ | $\mu\text{R h}^{-1}/\text{indicated concentration}$ |
| ⁴⁰ K | 0.179 | 1.49 per percent K |
| ²²⁶ Ra + daughters | 1.80 | 0.61 per $0.358 \times 10^{-6} \mu\text{g g}^{-1} \text{Ra}^b$ |
| ²¹⁴ Pb | 0.20 | 0.07 per $0.358 \times 10^{-6} \mu\text{g g}^{-1} \text{Ra}^b$ |
| ²¹⁴ Bi | 1.60 | 0.54 per $0.358 \times 10^{-6} \mu\text{g g}^{-1} \text{Ra}^b$ |
| ²³⁸ U + daughters | 1.82 | 0.62 per $\mu\text{g g}^{-1} \text{ }^{238}\text{U}$ |
| ²³² Th + daughters | 2.82 | 0.31 per $\mu\text{g g}^{-1} \text{ }^{232}\text{Th}$ |
| ²²⁸ Ac | 1.18 | 0.13 per $\mu\text{g g}^{-1} \text{ }^{232}\text{Th}$ |
| ²⁰⁸ Tl | 1.36 | 0.15 per $\mu\text{g g}^{-1} \text{ }^{232}\text{Th}$ |
| ²¹² Bi | 0.09 | 0.01 per $\mu\text{g g}^{-1} \text{ }^{232}\text{Th}$ |
| ²¹² Pb | 0.09 | 0.01 per $\mu\text{g g}^{-1} \text{ }^{232}\text{Th}$ |

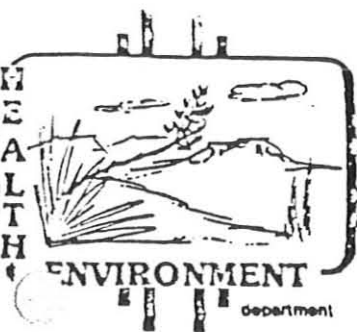
^a From Beck *et al.* (1972b).^b Concentration of ²²⁶Ra in equilibrium with $1 \mu\text{g g}^{-1} \text{ }^{238}\text{U}$.TABLE 2-19—Calculated total exposure rate at one meter above ground for selected radionuclides distributed in the soil^a

| Isotope | Source Activity mCi km^{-2} | Source distribution (α/p in $\text{cm}^2 \text{g}^{-1}$) | | | | | |
|--|---|---|----------------------|----------------------|----------------------|----------------------|----------------------|
| | | 0.0625 | 0.206 | 0.512 | 0.625 | 6.25 | (Plane) |
| | | $\mu\text{R h}^{-1}$ | $\mu\text{R h}^{-1}$ | $\mu\text{R h}^{-1}$ | $\mu\text{R h}^{-1}$ | $\mu\text{R h}^{-1}$ | $\mu\text{R h}^{-1}$ |
| ¹³⁷ Cs | 1.0 | 6.25(-5) ^c | 1.34(-4) | 1.56(-4) | 1.96(-4) | 2.86(-4) | 3.27(-4) |
| ¹³⁷ Cs + ^{137m} Pu | 2.0 | 1.85(-4) | 3.51(-4) | 4.05(-4) | 5.03(-4) | 7.22(-4) | 8.34(-4) |
| ¹³⁷ Cs | 1.0 | 2.60(-4) | 6.23(-4) | 6.21(-4) | 7.65(-4) | 1.15(-3) | 1.31(-3) |
| ¹³⁷ I | 1.0 | 1.56(-3) | 2.92(-3) | 3.35(-3) | 4.20(-3) | 6.91(-3) | 7.28(-3) |
| ¹³⁷ Sb | 1.0 | 1.77(-3) | 3.33(-3) | 3.82(-3) | 4.86(-3) | 7.14(-3) | 8.29(-3) |
| ¹³⁷ Ba | 1.0 | 7.74(-4) | 1.45(-3) | 1.69(-3) | 2.09(-3) | 3.16(-3) | 3.66(-3) |
| ¹³⁷ La | 1.0 | 8.96(-3) | 1.63(-2) | 1.88(-2) | 2.40(-2) | 3.56(-2) | 3.96(-2) |
| ¹³⁷ Ba + ^{137m} La | 2.15 | 1.11(-2) | 2.02(-2) | 2.33(-2) | 2.97(-2) | 4.40(-2) | 4.92(-2) |
| ¹³⁷ Ru | 1.0 | 1.97(-3) | 3.66(-3) | 4.30(-3) | 5.37(-3) | 7.90(-3) | 9.22(-3) |
| ¹³⁷ Ru + ^{137m} Rb | 2.0 | 7.74(-4) | 1.43(-3) | 1.67(-3) | 2.11(-3) | 3.17(-3) | 3.65(-3) |
| ¹³⁷ Cs | 1.0 | 2.31(-3) | 4.29(-3) | 4.99(-3) | 6.17(-3) | 9.34(-3) | 1.06(-2) |
| ¹³⁷ Zr | 1.0 | 3.02(-3) | 5.51(-3) | 6.36(-3) | 7.81(-3) | 1.17(-2) | 1.35(-2) |
| ¹³⁷ Nb | 1.0 | 3.15(-3) | 5.74(-3) | 6.66(-3) | 8.14(-3) | 1.24(-2) | 1.41(-2) |
| ¹³⁷ Zr + ¹³⁷ Nb | 3.155 | 9.91(-3) | 1.79(-2) | 2.07(-2) | 2.54(-2) | 3.84(-2) | 4.39(-2) |
| ¹³⁷ Mn | 1.0 | 3.40(-3) | 6.29(-3) | 7.22(-3) | 8.88(-3) | 1.34(-2) | 1.54(-2) |
| ¹³⁷ Co | 1.0 | 9.99(-3) | 1.80(-2) | 2.06(-2) | 2.55(-2) | 3.78(-2) | 4.32(-2) |

^a From Beck *et al.* (1972b).^b Assuming daughter is in equilibrium with parent; exposure rate is for 1 mCi km^{-2} of parent activity.^c Format of 6.25(-5) = 6.25×10^{-5} .

emitters uniformly distributed in the ground, and not too different for the main fallout radionuclide, ¹³⁷Cs. This suggests that a flux density measurement at 100 meters can be related to a one meter exposure rate fairly accurately. This has been demonstrated in several air-ground intercalibrations (e.g., Pensko *et al.*, 1971; Burson *et al.*, 1972).

The calculated results such as those in Tables 2-18 and 2-19 are slightly different from data previously reported by the same group (e.g., Beck and de Planque, 1968) and others as summarized by



STATE OF NEW MEXICO

ENVIRONMENTAL IMPROVEMENT DIVISION
DISTRICT I - P.O. Box 2536
Milan, NM 87021 Tel. #287-8845
RUSSELL F. RHOADES, Director

Bruce King
GOVERNOR

George S. Goldstein, Ph.D.
SECRETARY

MEMORANDUM

TO: Jerry Stewart, Radiation Protection Bureau .
FROM: Theodore G. Brough, Environmental Scientist III, Milan
DATE: October 12, 1982
SUBJECT: RADON MEASURED AT RANCHER'S JOHNNY M MINE

Four Radon gas samples were taken over the earth covered, cleaned up areas at the backfill operations of the Johnny M Mine. The results are as follows:

Sampling time September 1-3 (48 hour bag sample):

Near North Bore Hole = 0.49 pci/l

200 ft. W. of N. Bore Hole, over fill = 0.77 pci/l

Near South Bore Hole = 0.38 pci/l

300 ft. S. of South Bore, over fill = 0.91 pci/l

Simultaneous 24-hr. Radon measure at Feight, Sta. 414 = 1.99 pci/l
(average 2 yr. conc = 1.60 pci/l)

Simultaneous 48-hr. Radon measure at Milan, Sta. 211 = 0.67 pci/l
(average 2 hr. conc = 0.358 pci/l)

Since the concentrations at the two check points (414 and 211) were 1.60 and 1.86 times their respective 2-yr. averages, (av = 1.55 x), the Ranchers samples are deduced to be 1.55 times their respective annual averages. Correcting, we get as a probable annual average:

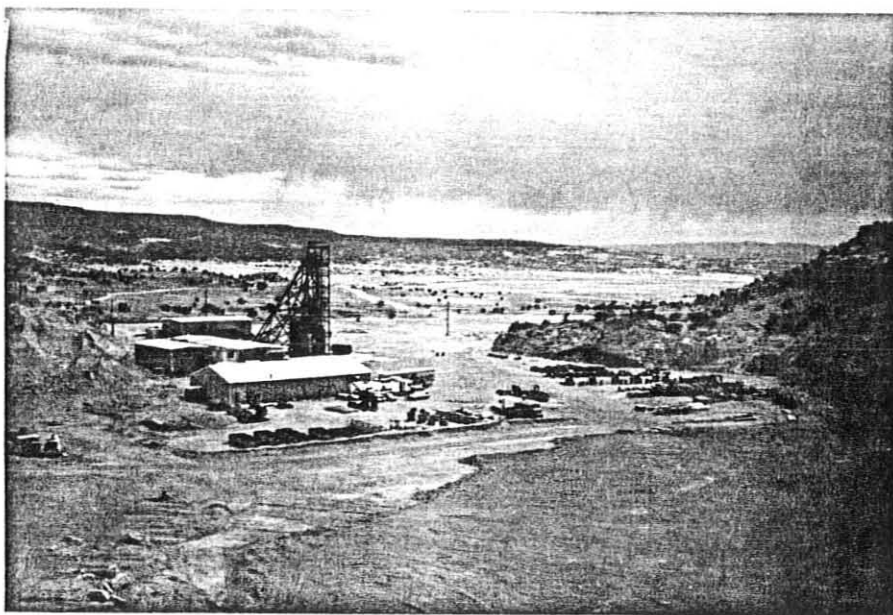
N Bore Hole area = $0.41 \pm .16$ pci/l

S Bore Hole area = $0.42 \pm .24$ pci/l.

jg

xc: Charles Landauer, Santa Fe
Jere Millard, Santa Fe
File

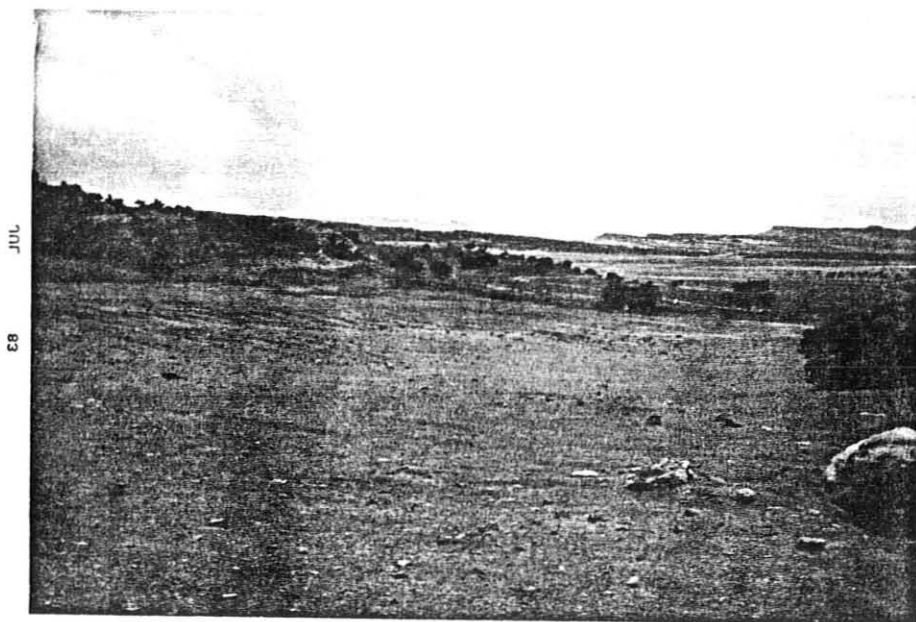
JUL
83



JUL
83



Top #13
Bottom #18



Top #22
Bottom #30